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solplan review

the independent journal of energy conservation, building science & construction practice

Inside . . .

Once in a while it's good to stop and look back where we've been and where we're going. As this is our 50th issue, we thought we'd take a look back over the past few years.

Rob Dumont presents a brief historical overview of low energy housing for cold climates.

Looking back, we find that some topics and items we've carried are still current. One of these is the issue of ventilation in modern homes. We reprint an item first run in October 1986 on the subject that is still current.

At the same time we look back, we have to be sure that we learn from past project. The monitoring of an R-2000 multi-family building in Whitehorse provides information that we hope will not be lost, but put to good use.

But not all is a look back. Other items include a discussion of septic systems and an option that is being used in the B.C. Advanced House, a review of proposed changes to the National Building Code, R-2000 technical standards, and much more. To help you keep track, we've prepared an index to the past 49 issues.

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Our 50th Issue!

From the publisher. . .

When planning this 50th issue I thought it timely to take a look back over the past few years. In the overall scheme of things, 8 years is not a long time, although I am told that in the publishing industry it could be old age.

When I started this publication in 1985, the R-2000 program was in full swing. The R-2000 builder workshops were doing something that had never been done before - a dedicated effort to upgrade the building industry. Building science principles as well as new building technologies were being communicated to an industry where industry wide training was not known. While some trades have apprenticeship training and licensing, many do not. Knowledge is traditionally passed on by on-the-job training. While this is not altogether bad, it also passes on mistakes from generation to generation.

I observed that there was much interest and although everyone was not rushing out and building R-2000 homes after taking the training workshops, there was a great interest in new developments and technologies. However, the R-2000 Program was not successful at following through with continuing information transfer.

There seemed to be a decided lack of vehicles to keep the communication flowing. Having dabbled with publications in the past, and in a weak moment it seemed that it might be a good idea to do something to keep the information process moving.

With no budget, limited market research, and the support of a small band of the lunatic fringe in the building community on the West Coast (which included Warren Jones, David Hill, Yvonne Kerr, Al Koehli, David Blythe, Ray Cole, Sebastian Moffat, Willis Graham and Terry Lyster), Solplan Review was started. It took no time to recognize why there were no other publications of its kind - as a business proposition this effort is almost without merit! We very much depend on paid subscriptions to maintain the enterprise; the limited amount of advertising helps with production costs.

However, while there may be no money in the enterprise, it has been an inspiring and interesting exercise. Judged by the feedback received over the past few years, we seem to have struck a chord. I hope we can keep improving in the future.

Richard Kadulski
Publisher

Some observant readers may have noted that this issue is late. We hope to get back to a regular schedule with the next issue.

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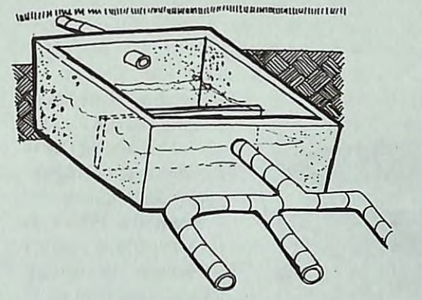
Septic Systems

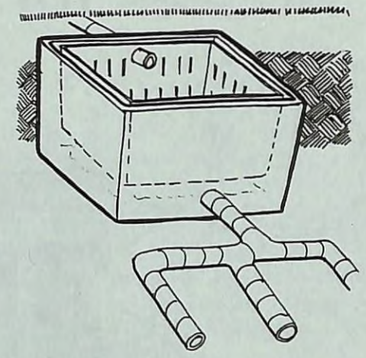
When you build in the city and can hook up to municipal services you don't have to think about how the sewage is treated - you just tie in to the sanitary sewer and that's it. Mind you, at the municipal scale we have to start thinking about how the sewage is treated.

Rural residents don't have any options. An on site sewage disposal system has to be installed. The typical approach is the septic tank and tile field. The conventional tank is a two chamber unit; solid wastes are supposed to settle in the first chamber where natural decomposition processes take place, and the second chamber gets the balance of solids settling out. Only liquid waste goes to the tile field where it percolates into the ground and natural bacteria does further treatment.

But do these systems really work? Too often, not well. In many areas there is evidence that natural water bodies and ground water aquifers have been contaminated by residential septic systems.



Conventional Septic tank system



Shasta Flush system

Current Septic System Problems

The sludge does settle but is not decomposed fast enough or adequately because it remains in the water, so that in many cases unless the septic tank is pumped regularly, the sludge is pushed into the tile field, where it quickly gets plugged up and stops functioning.

In Ontario, where all construction is covered by warranty, the Ontario New Home Warranty Program has had many claims due to failure of septic systems - many within 7 years of installation. 30% of all systems are failing prematurely. The cost to consumers for failing systems within the first 7 years of operation is estimated to be $75 million.

To assess the liability associated with sewage disposal systems, the Ontario New Home Warranty Program conducted a study of requirements, approval processes and failures of private sewage disposal systems throughout the Province of Ontario. 31% of failing systems failed due to poor design, poor construction or inaccurate soils information. 17% of failed beds were estimated to fail due to insufficient maintenance.

On average, about 41% of septic beds fail due to old age. On-site systems are not expected to have an unlimited lifetime but based on the results of the survey, a life of 10 to 15 years is realistic, and from an industry perspective often 20 years is considered a normal lifetime for a properly designed and maintained leaching bed.

The Ontario study suggested that liability could be reduced by ensuring all designers, contractors and approval agencies have adequate knowledge to ensure sound design, construction and operation. It was suggested that qualified engineers be required to design, inspect and certify all private sewage disposal systems within subdivision plans. In addition, an information package be developed for new homeowners explaining the operation and maintenance of an on-site sewage system. As well it suggested that health inspectors, consultants, and contractors should be better educated with regard to the design, approval and operation of individual sewage systems.

It was also noted that actual design flows correspond more closely to the number of fixtures in the house, than number of bedrooms as is called for by standard guidelines.

An Alternative

In conventional septic systems the solids, not the liquids, create most of the problems. Because the solids are in constant liquid contact, decomposition is slower. An alternative system that separates solids from the liquids, so that *aerobic* decomposition can take place, is being manufactured in California. Monitored studies in California showed that the solid waste build up for a family of 5 was 2 inches deep after 10 years.

The Shasta Flush System has been installed in the B.C. Advanced House and will be monitored to prove its performance. Because the Advanced House is built in an urban subdivision with a sewer system, the liquid effluent will go into the sewer, rather than a tile field. The benefit for the community is that it reduces the sewage treatment required.

If it were hooked up to a tile field, it would reduce the problems of solids in the tile field, thus extending its life.

The system has been used for several years in California. Worldwide Essential Products Inc. is planning to distribute the system in Canada, subject to obtaining all regulatory approvals.

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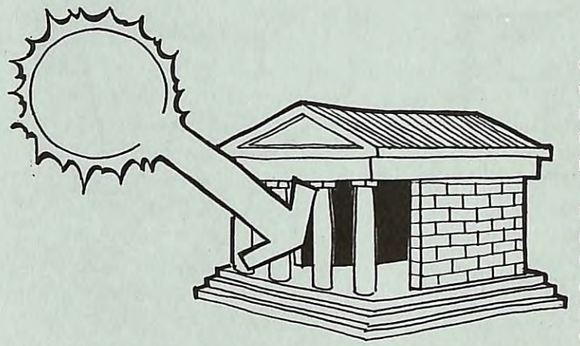
A Short History of Low Energy Houses for Cold Climates

Robert S. Dumont



It's impossible to write a history of low energy housing without recognizing the knowledge accumulated over 25 centuries of civilization. The most outstanding early contribution was the emphases placed on the orientation of the houses to improve the solar heat gains.

The ancient Greek philosopher Socrates said: *"In houses that look toward the south, the sun penetrates the portico in winter, while in summer the path of the sun is right over our heads and above the roof so that there is shade".*

The playwright Aeschylus suggested that a south-facing orientation was a normal characteristic of Greek homes of his time. It was a sign of a *"modern"* or *"civilized"* dwelling as opposed to houses built by primitives and barbarians who, *"though they had eyes to see, they saw to no avail; they had ears, but understood not.... They lacked knowledge of houses.... turned to face the sun, dwelling beneath the ground like swarming ants in sunless caves.*

In the 20th century there have been many breakthroughs or inventions that have allowed us to improve the energy efficiency of houses, but it is still the orientation of the house towards the sun for passive solar heating that is the key to achieving superior performance.

From the 1930's to the 1970's a small amount of innovation took place in the area of energy efficient buildings. Sealed pane windows, vapour barriers and forced warm air furnaces were developed. Very little progress occurred in the use of higher insulation levels. As late as 1975 houses were being built in Saskatchewan with as little as 2½" (60 mm) of wall insulation.

Innovative houses of the 1970's

A little known super energy efficient house was built in 1975 near Copenhagen, Denmark. Professor Korsgaard of the Technical University of Denmark was the key technical innovator on this project. Called the *Zero Energy House*, this house was unique in that it was probably the first super-insulated house in the world.

The Saskatchewan Conservation House built in 1977 in Regina, Saskatchewan, (a cold climate - 5901 heating degree-days/18°C) incorporated a number of innovative energy conserving features: including high performance evacuated tube solar collectors, a grey water heat exchanger, an air to air heat exchanger using plastic heat transfer surfaces, exterior, motor driven insulating shutters, and a well sealed air-vapour barrier.

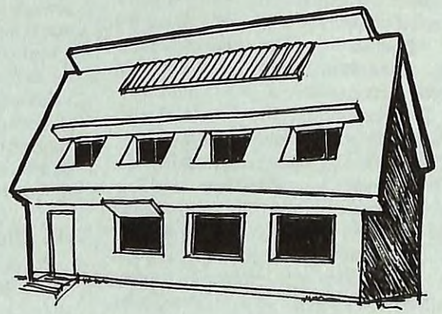
Based on test results this was the tightest house constructed in Canada with 1.3 air changes per hour at 50 Pascals pressure difference; under natural conditions, the average air change rate is less than 0.1 changes per hour.

The house had modest south-facing windows for passive solar gain in a light frame building with no additional thermal mass, and was designed for 100% solar heating.

The insulation levels were very high for houses at that time. R40 (RSI 7) cellulose insulation was used in the floor, R60 (RSI 10.7) ceiling and R47 (RSI 7.7) fibre glass bats in the walls.

Technical input for the house was spearheaded by: Professor Robert Besant of the University of Saskatchewan, Harold Orr of the National Research Council and David Eyre of the Saskatchewan Research Council.

Because of the relatively high cost for the solar collectors, the teething problems with pumps, sensors, and control-



Saskatchewan Conservation House

lers, the use of solar collectors for space heating did not seem attractive. Use of solar panels for space heating never became popular in Canada, but many of the other conservation features used including the air-to-air heat exchanger, the well-sealed envelope, the modest south-facing windows and the use of high insulation levels proved to be more attractive.

Passive Solar Heating

The use of large south windows with large amounts of thermal mass was very popular in the south-west of the US (sometimes referred to as the "mass and glass" approach to solar design). The use of modest south facing windows along with large amounts of insulation and a well sealed building envelope is known as the "light and tight" approach. But even in a well insulated house a standard double glazed window facing south in a Saskatoon home will actually have a net heat loss over the winter months.

In the 1980's, much improved high performance windows reached the market. Windows incorporating low emissivity (low-e) coatings and low conductivity gases such as argon became commercialized. One Canadian manufacturer is constructing windows with centre-of glass R values as high as R8.3 (RSI 1.5). For comparison purposes the thermal resistance of a standard double pane window is only about one-quarter that amount.

In 1980, following on the success of the Saskatchewan Conservation House, a project of 14 houses called the Energy Showcase was built in Saskatoon.

A major innovative feature of the project was the use of a performance target for space heating instead of prescriptive targets. For these 14 houses, the annual space heating target was set at 200 MJ/m² (55.5 kWhr/m2) or about 1/3 that of conventional houses. In addition, the air tightness target set for the houses was 1.5 air changes/hour at 50 pascals.

Because of the absence at that time of easy to use tools to calculate the annual heating performance, a series of computer programs were written - which became the base for HOT2000, which allows the builder or designer to estimate the yearly space heating consumption of a house before construction.

At the Energy Showcase project a number of innovations were tried. These included the use of a single hot water heater to provide both space and water heating, use of quadruple pane windows, various window insulating schemes, and very high insulation levels - one house had R60 (RSI 10.5) walls.

A Brief History of Low Energy Housing in Canada

Building	1970's Average New Home	1978 Saskatchewan *Conservation House*	1980's *R2000 Homes*	1989 Brampton *Advanced House*	1993 Waterloo *Green Home*[1]
Design Objectives		Reduce energy consumption	Reduce energy consumption	Reduce non-heating energy consumption	Minimize energy & water use & ozone-depleting materials Maximize use of re-cycled & waste building materials
Construction Details	Single stud walls 100 mm insulation Single pane windows Unsealed vapor barrier Incandesant lighting	Double stud walls 300 mm insulation Double glazed windows w/ insulated shutters Air-tight vapor barrier Hand-built heat-recovery ventilator (HRV)	Double stud walls 300 mm insulation Double glazed windows Air-tight Vapor barrier Heat Recovery Ventilation	Double stud walls Insulated basement walls and floor Windows: triple glazed, gas filled, low-e, insulated edge spacers Air-tight vapor barrier Integrated mechanical system with heat pump to capture waste heat & Ventilation air preheated in sun-space Low water-use appliances/fixtures Energy efficient ciculation & exhaust fans Low-energy fridge (20kWh/mth) Fluorescent lighting	•Basement walls: pre-cast concrete/mesh reinforced—50% less concrete than poured walls •Above grade walls/main floor: high strength, laminated I-beams–30% reduction in lumber usage •Highly insulated building shell •High performance windows •Solar water heater •Energy-efficient appliances & lighting •Integrated furnace/HRV system •75% reduction of water use: low-water appliances/fixtures; rainwater cistern for toilets, washer, outside taps; drought resistant landscaping •HFC R134a fridge & CFC-free cooling system •Recycled Bldg materials[2]
Airtightness ACH*	7	less than 1	1.5		
Energy Load kWh/m² **	200	78	100 only 40% space heating	40	50

**Air change per hour (at 50 Pascals of pressure)*
***Kilowatt hours (of energy use) per square meter of heated floor space*

[1]Waterloo *Green Home* is one of the ten Advanced Concept Houses presently under construction.
[2]Cellulose insulation –100% recycled newspapers Masonite siding–compressed sawdust waste
Perimeter drainage– crushed glass& concrete waste Steel roofing –25% old cars

Unfortunately, in 1980 there were almost no high efficiency residential water heaters.

The R-2000 Program

A major initiative in low energy housing was announced in 1980 by the Canadian Federal Government Department of Energy, Mines and Resources (EMR). The program became known as the R-2000 program. Mark Riley of EMR played a key role in the development of R-2000.

The program had a strong emphasis on performance, as opposed to prescriptive standards for energy use for space heating. In the Saskatoon and Regina climate zones, the annual space heating performance target is about 60 kWhr/m².

Perhaps the greatest contribution of the R-2000 program has been the education programs for the contractors and trades people. In addition, excellent standards work was done in the area of heat recovery ventilators and indoor air quality.

The Advanced House (Brampton)

In 1989 a second generation low energy house was built in Brampton, Ontario (near Toronto). Elizabeth White and Greg Allen were the key people on this project.

The Advanced House incorporated state of the art energy efficiency measures and has a total energy consumption of about 40 kWhr/m2. per year. A major innovation in this house was the use of very efficient lights and appliances to reduce the base electricity consumption of the house. In addition, an innovative heat pump system is used to provide space heating, water heating, ventilation, and cooling.

In 1991, a program to build a series of Advanced Houses was initiated by EMR and the Canadian Home Builders' Association. In addition to reduced space heating loads, the program also targets reduced energy use for domestic water heating, lighting, and appliances. The target is to reduce the total energy consumption of the houses by 50% compared to the R-2000 target. It also includes reducing water consumption, using recycled products, addressing indoor air quality guidelines, and providing facilities for recycling of materials.

Is a Zero Energy House possible in a Cold Climate?

A reasonable question to ask is whether it would be possible to extend the energy conservation and renewable energy features and build a house in a cold climate such as Saskatchewan that was completely autonomous in its energy supply.

Technically, it's feasible. Here's how.

Water Heating

The water heating load could be provided by a solar system coupled with water storage. An average house with water saving features uses about 4000 kWhr/yr for domestic water heating. A solar collector with 40% annual efficiency can collect about 550 kWhr/m². of useful heat, so 7 square meters, with larger water storage, could provide the domestic hot water.

Space Heating

Space heating could be provided by using a highly energy efficient envelope for the building coupled with super-window technology.

Electricity for Lights and Appliances

The supply of electricity is the most expensive element. In a windy location in a rural area, a wind electric system could be used. In an urban area, it would appear that photovoltaic cells would be the most attractive. The price of cells will soon approach $ 2.00 per peak watt (presently it's about $8 - 10.).

Is it economically justified to build a completely autonomous house? What is the real cost of energy?

In addition to the cost of extracting, processing, and delivering energy, there are very substantial environmental costs which today are not being paid. There is no charge to the consumer of energy for all the pollutants released into the atmosphere from the burning of fossils fuels. (Carbon dioxide levels in the atmosphere are now 25% higher than a century ago, and are rising each year).

Much progress has occurred since the 1970's in our understanding of how to build energy efficient houses. Houses that use 80% less energy than conventional 1970 houses have been built.

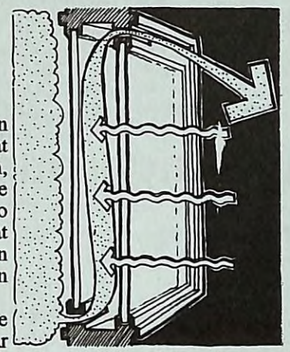
With concern about the harmful environmental effects of fossil fuel burning increasing, it is possible that cold-climate houses that are completely autonomous in their energy supply using solar energy will be built in the 1990's.

What ever happened to. . .?

Occasionally we highlight new products that show some promise to improve housing. Looking over past issues, we've noted some items that sounded good at the time, but haven't caught on, or have fallen by the wayside. Some of these still are a good idea given the chance.

Dynamic Windows

(Solplan Review No. 14)



In April 1987 we presented John Timusk's discussion of the dynamic wall, which is based on the principle that if a house is kept under negative pressure by an exhaust fan, a gentle stream of fresh air is drawn in through the insulation, the air is warmed by the heat otherwise lost to transmission through the wall, so that the wall acts as a heat exchanger. The incoming air could satisfy ventilation needs. Examples of the dynamic wall have still been experimental or prototype.

We also pointed out that research work was being done on dynamic windows. We've since learned that Willmar windows had actually prepared some prototype windows and test marketed them in the Montreal area, but sales were not exceptional. However, it seems that the dynamic window could be important for multi family ventilation in milder climates. For example, on the west coast exhaust only ventilation strategies for apartments make sense, but the supply inlet is more difficult to install. Combining the window with the ventilation systems seems like an idea that should be pursued.

Thermo Structures Building System

(Solplan Review No. 5)

This was one of several EPS foam wall systems that emerged in the past few years. While some, such as Insul-wall and Nascor have survived, the Thermo structure did not. This simple system featured preformed 4 x 8 expanded polystyrene insulation panels which interlocked with a preformed interlocking edge joints to form rigid, airtight panels. The system incorporated standard frame construction, as the foam formed a framing table (the panels were grooved at 16" centres). Some 150 or more houses were built using the system.

So what happened? Not much. The enterprise seems to have been lost in the venture capital financing game that they play on the Vancouver Stock Exchange.

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Reprinted from Solplan Review No. 11, Oct-Nov. 1986

The Vancouver Sun, Saturday, Oct. 18, 1986 ★★★★

Bad air: it's enough to make you sick

WHEN lack of space forced us to vacate our turn-of-the-century home, we decided to go modern. That meant veneers, plastic and wallboard. It also meant, I decided, a forced air heating system with built-in air conditioner and humidifier. No more would I have to bleed radiators and fill room humidifiers. But the house didn't come with any instructions. All we were told was that the thermostat controlled everything.

I discovered that the furnace had filters, and then discovered that the humidifier sat on the side of the furnace. I removed the lid to find a drum covered in sponge made so hard by mineral deposits that it would have cracked had I dropped it on the floor. The water in which the drum sat was yellow and covered with a slimy, greasy sludge. What had this marvel of modern technology been discharging into the air we breathed aside from water vapor?

HOWARD SEIDEN M.D.

I immediately thought of legionella pneumophila, the bacterium that causes legionnaires' disease. These organisms can, midifier?

It's been estimated that from one to 13 per cent of pneumonias are caused by members of the legionella family, the bacteria are also responsible for another form of illness called Pontiac fever. Symptoms include fever, chills, headache, muscle aches, diarrhea, joint pains, shortness of breath and dr cough.

I collected some samples whic sent to a lab that processes bl and urine samples. As I recall, routine bacteriology grew a F domonas species. The legic culture I requested wasn't do to red tape or something.

I pulled the humidifier the parts and

tioner powder which the package sa ves and prevents rust, algae and clog-

mer.

aise, weakness, dry cough and progressive shortness of breath. Symptoms began about 5 or 6 p.m. and lasted about 12 hours. On weekends, he felt relatively well.

The authors of the report noted rities between their cases Lung, Bagassosis 's disease ings to

Building air systems may make you sick

Trying to keep the evil winds out of our homes while, at the same time, ensuring that our internal environments are carefully controlled we have developed a new disease. It's called sick building syndrome or building sickness.

The real problem tends to occur in modern offices with air

extrinsic allergic alveolitis develops, symptoms resolve when the environment is cleaned up.

Then there is humidifier asthma. In a 1985 study, 14 different asthmatic types, nine bacterial and four different actinomycetes and four different protozoa types were found in the humidifiers of a factory where 47 workers had breathing symptoms. Of the 10 workers who continued to record breathing tests after the humidifiers were cleaned, all showed improvement but four continued

ments. The following symptoms were more common in the latter buildings: blocked, itchy nose; itchy, irritated, itchy runny nose; itchy, irritated, stuffy nose; watery eyes; dry throat; stuffy nose; chest tightness; headache; dry skin; lethargy. According to the authors, the probability that the bad luck of the draw or statistical chance caused the excess of symptoms in the midified buildings was one in 1,000.

Indoor Air: Is It Dangerous to Your Health?

A nationally syndicated, medical column which appears in major Canadian newspapers recently discussed indoor air quality. The columns, written by a doctor, underline the ignorance that exists among the general population about the importance of a sound maintenance program for household mechanical equipment.

A leaky roof or tap is easy to see and fix, but improperly functioning equipment will not be recognized quickly. The problem often are invisible. For the low energy builder, and the R-2000 Program, the challenge is to educate the public and overcome fears about tightly built houses. There are problems with new construction practices, but these have been, and are continuing to be, dealt with in a systematic fashion by the program.

Unfortunately, copy-cat houses built outside the regulation of the R-2000 Program, often at the insistence of owners who want to cut corners but don't quite understand the consequences of not following a carefully thought out building system, are prime targets for problems. The most important R-2000 criteria is the requirement for balanced ventilation.

The author of the column (talking about his new house) points out that:

the house didn't come with any instructions. All we were told was that the thermostat controlled everything. I discovered that the furnace had filters, and then discovered that the humidifier sat on the side of the furnace.

I removed the lid to find a ....sponge made so hard by mineral deposits that it would have cracked had I dropped it .... The water..... was yellow and covered with a slimy, greasy sludge. What had this marvel of technology been discharging into the air we breathed....?

Legionnaires disease and other respiratory diseases have been identified with faulty air conditioning systems. The implications are clear - faulty or poorly maintained ventilation systems can create considerable health problems. There is considerable documented evidence to prove this.

Indoor air quality problems, mainly in commercial buildings (the 'sick building' syndrome) has received much attention. In most cases these are directly related to completely sealed buildings that rely on central heating/ventilation (HVAC) plants, where design or maintenance faults can lead to conditions that make it difficult to maintain good air quality.

A major feature of the modern building with a central HVAC is that the *only* source of air is through the central system so if there is a problem with the HVAC system all occupants will suffer. However, HVAC systems, like the choke on your car, can be throttled down too far.

In recent years, people have begun to sense that something is wrong with these central systems in their work environments. This is why they become concerned about talk of *airtight* houses.

As any low energy builder will appreciate, even the tightest house does not present the same situation because the house still has windows that open - and in each room at that! The resident can easily control his own environment. If it gets too stuffy, the window can be opened. As well, a properly built "tight" house will contain a ventilation system of some sort. Unfortunately, not many people understand that as ventilation systems for houses is a new idea for most.

Up to now, balanced ventilation systems in traditional housing have been the exception rather than the norm. Continued R-2000 Program monitoring has proven that indoor air quality in a well built and designed house will be better than in conventional houses.

R-2000 builders are already familiar (and hopefully thoroughly committed) to the need for balanced ventilation.

The Homeowner's Part

You can have the best designed ventilation system, but if it is not maintained properly, it will not do any good. As the doctor pointed out in his column, some parts of the system may well provide the ideal conditions for breeding bacteria strong and nasty enough, that the air in the house could be hazardous to the health of the resident.

We know that many people are not familiar with or keen enough to maintain their house properly. Those of us in the building community may find this hard to understand. After all, it's not that hard to change a filter in the furnace, is it? But then because that is our livelihood, it is second nature to us. It seems so simple to tell a new homeowner to "be sure the filters are changed 2 or 3 times a year, and etc...." But you have to remember to do it!

But the homeowner, who may be a doctor, banker, salesman, teacher, stockbroker, or whatever is often much more interested in other things. To him, an ordinary furnace or hot water tank is a technological marvel with strange knobs, screws, and pipes whose meaning and purpose is totally unknown (and he may be afraid of breaking the whole thing if he touches something the wrong way).

To do any regular maintenance he has to remember that the equipment is there. If it is located in some dim part of the basement or crawl space, it will be forgotten (or not even discovered!) until something goes wrong.

(Personally, that's the way I deal with my car - I know where to put the gas and how to turn the key, but if something goes wrong, it's panicsville! Just what are all those things under the hood?)

Why place so much stress on ventilation systems and their upkeep?

We know that in recent years natural air leakage into houses has been reduced by improved construction techniques. Pollutants are always generated indoors due to people, occupancy activities and combustion appliance by-products.

Balanced ventilation systems or occupancy are not meant to provide combustion air but if there were an inadequate supply of combustion air, the ventilation system will tend to reduce build up of toxic gases and ensure that the indoor air was constantly flushed clean.

So what is the solution to a healthy, sound design?

There are a few points that the builder should keep in mind.

Firstly, above all, the system should follow the **KISS** principle:

keep it simple, stupid.

Secondly, Murphy's law should be accepted as a given. If something can go wrong, it will. A simple design, with a minimum of complex parts that can break down should be used. Always assume the worst possible scenario.

Thirdly, when selecting equipment, look for the best, most durable, easily serviceable equipment. If it is worthwhile to use a complex piece of equipment, look for its track record, warranty provisions, and availability of service and parts. (Why use a piece of equipment that can only be maintained by factory trained service personnel in a location where personnel are not available and if parts are need, it will take two weeks to airlift them?)

If the equipment has filters that require periodic maintenance (perhaps several times per year) don't place the equipment in a spot that only a 4 foot tall Olympic gymnast can easily get at. Some HRV's have filters inside the main unit, which should be cleaned several times a year, yet we have seen units located in very shallow crawl spaces, hard to get at attic spaces, or hanging high in a workshop - any guesses how often those filters will be changed? How many homeowners (assuming they've been told) will remember to change or clean the filters after two years of occupancy? We won't even think about the second purchaser.

And finally, a simple user's manual should be provided - something simple - even a one page typewritten list of points to check and maintenance to perform. This could be attached next to the electrical panel (everyone finds it sooner or later).

Reprinted from Solplan Review No. 11, Oct-Nov. 1986

Concerns About Venting

by David Hill and Yvonne Kerr

Stack Action Against the Ventilation Industry

Has anyone in the energy efficient housing industry not heard the line "but I don't want my home too tight. I like the idea of some fresh air getting in"?

What follows is usually a difficult sales pitch: the benefits of stopping *natural* ventilation (drafts which cost comfort and energy) and the benefits of *forced, mechanical* ventilation (which costs even more money).

Which sounds better to you: "The *natural* taste of orange juice" or "the *mechanical* taste of orange juice"? Just how *natural* is natural ventilation?

A Crude Awakening

The only reason to call *natural* ventilation natural is because it's common to the traditionally built home. But there's nothing natural about it. A more accurate word would be "crude". Because leakage occurs at random locations, air change is different in all parts of the home. It changes from season to season and even throughout the day as temperatures change. Further, leakage air change most often happens at the floor level where it provides no benefit to the head space where fresh air is really required. The building envelope is the crude ventilation.

Stack action is the force which makes hot air rise. Cold outdoor air is drawn inside to replace the hot air which is lost into the attic directly or via partition wall cavities. Cold air is heavy and will "pool" on the floor. Unfortunately this force is silently at work in all of our houses. These drafts are far less dramatic than wind-driven drafts, but have far greater impact. Unlike wind, the drafts from stack action continue non-stop throughout the heating season. These strike two and three storey homes hardest and are most severe during cold weather. A building envelope with leakage spots is an unsatisfactory and crude form of ventilation. It 'works' whenever it wants and rarely, if ever, when you want it to.

Assuming a warm summer outdoor temperature, open windows for ventilation are quite acceptable. During the fall,

however, the combination of moist, foggy outdoor air and the need to close windows for warmth confines occupant generated moisture, making window condensation a common problem. With little or no wind or stack action during the autumn months, homes become very stuffy.

A very different situation develops during the cold winter months. Tremendous stack action driven by the difference in indoor/outdoor temperatures hyper-ventilates the home and dries it out. During this season, the crude ventilation is totally out of control. When the milder spring weather returns, stack action is reduced and the home again tends to become stuffy. Crude ventilation stands little chance of success when up against the natural elements.

Primitive Fan Fare

Two forms of primitive ventilation have indirectly pointed the ventilation industry in the right direction. About twenty-five years ago, homeowners who were not satisfied with 'hit and miss' crude ventilation demanded more control. Small cfm kitchen and bathroom fans were installed to provide localized exhaust. Cold outdoor air is drawn in even faster through leakage spots to replace the stale, moist air that (if properly ducted) is flushed outdoors. Aside from increased drafts, there are two major drawbacks to this form of primitive ventilation: small cfm fans move even smaller amounts of air once you add ductwork; and the less expensive fans are noisy. This type of ventilation does give the homeowner some control over exhaust, but does nothing for supply air control. And because of the noise, these fans are seldom used. Unless equipped with a sealed backdraft damper, these fans become just another hole in the building envelope.

An improved form of primitive ventilation relies on the homeowner to open and close windows in a well-built, draft-proofed home. Sealing leakage spots in the building envelope establishes the first step towards control of ventilation. Wind and stack action no longer have a dramatic effect on the air change of the home. Combined with openable windows, the homeowner has manual but accurate control of ventilation. The primary purpose of windows, however, is to provide natural light, passive solar gain into the home, and views to the outside. We would never accept small, high openable windows which would provide ideal cold weather ventilation.

A Step in the Tight Direction

From a control standpoint, a sealed building envelope with an intermittent or continuous exhaust fan is the first step towards a 'refined' ventilation system. The fan is controlled by a dehumidistat providing localized, humidity-sensitive exhaust with a manual over-ride option. This system is limited to electrically heated or sealed combustion appliance homes because there is no allowance for the supply air. Supply air must be sucked by 'brute force' through the few leakage spots remaining in the building envelope. Supply air comes in when you want, but not necessarily where you want it to.

Ventilation Systems Refined

A quality draft-proofed home equipped with a well installed central ventilation system meets almost all demands for a healthy, comfortable environment. Controls such as timers boost the low, continuous air change to a higher level on demand. The control of supply air allows installation of filtering to any degree the customer requires.

Because the capital cost of these systems is high and the cost is directly dependent on installed capacity, the cost-conscious housing industry is asking, legitimately, how much air do we need?

Sizing Up the Future

Experts have tested for specific pollutants in both conventional and airtight homes: formaldehyde, carbon monoxide, carbon dioxide, nitrogen oxides, humidity, moulds and dust, bacteria, viruses, radon and many others. The conclusion: provide enough ventilation to keep these pollutants at an acceptable level and perhaps provide an additional capacity 'just in case'. This additional capacity would hopefully take care of those pollutants we haven't yet discovered and act as a 'cushion of caution' for the industry. What if this cushion isn't enough? How much bigger is better?

Consider for a moment: is it really the building industry's responsibility to consider each and every possible action that a homeowner may or may not take? Should a builder build every home with six bedrooms just in case a couple decides to have a large family? Must every home have carport space for two large cars? Should space be provided in every house on the off-chance that a homeowner wants to build a sauna at some later date? Of course not. If a builder must provide for every possible activity and cottage industry that a homeowner could get involved with he would soon go broke.

Primary and Secondary Ventilation

Ventilation requirements that are common to every homeowner in every house must be considered PRIMARY VENTILATION. All else is SECONDARY.

Secondary ventilation needs cannot be uniformly regulated across the country. If the home building industry accepts responsibility for secondary ventilation requirements, the following would occur:

1. Comprehensive studies to identify radon areas would never take place;
2. No force would be directed at the building products industry to reduce formaldehyde levels
3. Homeowners would continue to load up their homes with harmful pollutants from paint studios, hairdressing salons, automotive repair shops and other irregular activities; and
4. The ventilation industry would have to assume responsibility for any new pollutants developed or discovered for years to come, a situation that would get totally out of control.

The buck has to stop somewhere!

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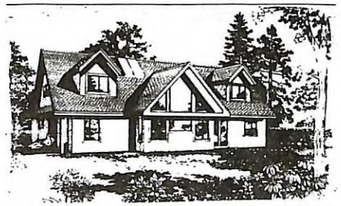

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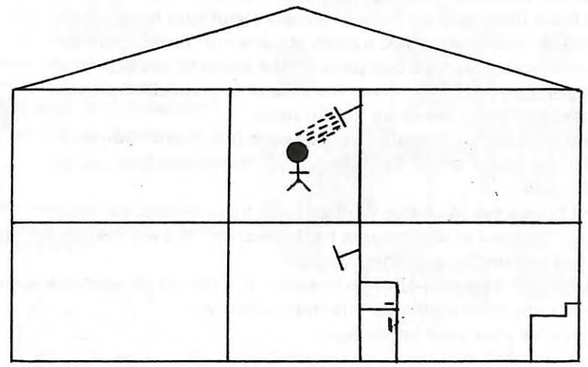

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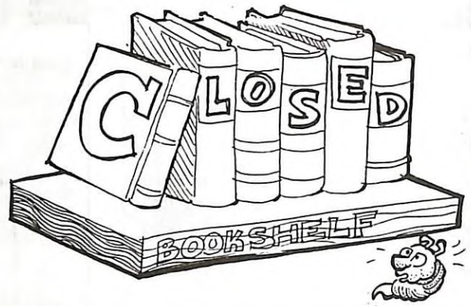

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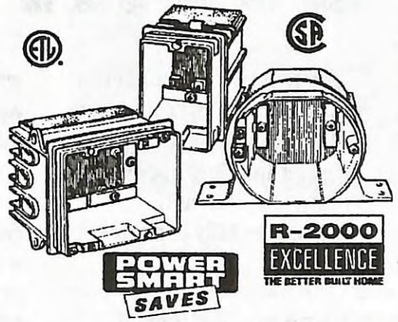

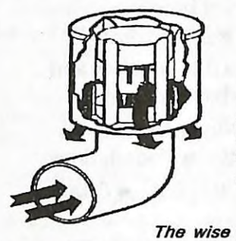

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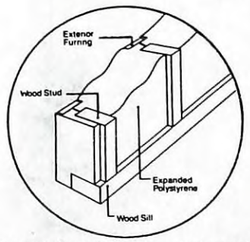

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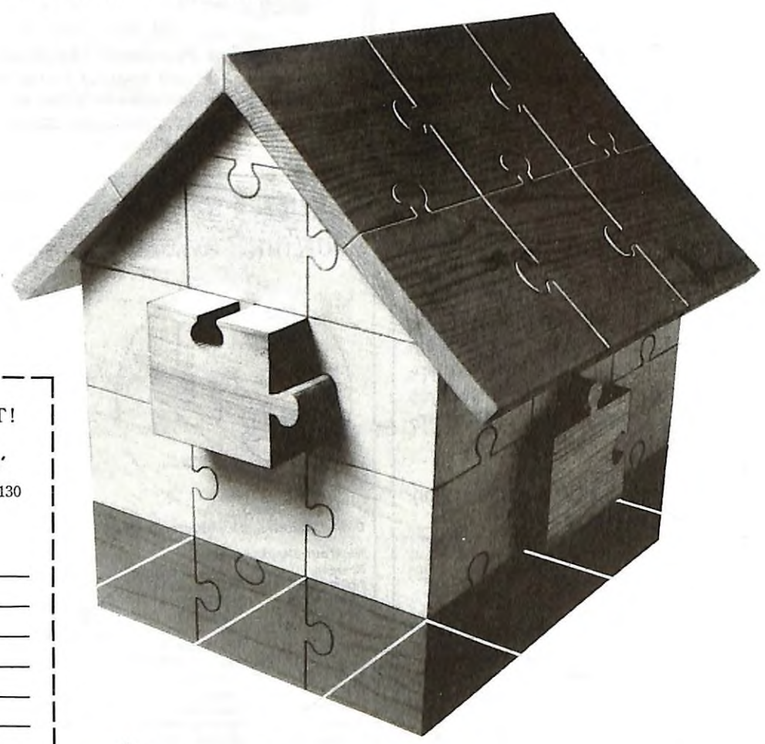

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The only logical solution is to stop secondary pollutants at the *source*, preferably before they enter the home. The 'simple' solution until now has been to assume that virtually all air pollutants can be dealt with by ventilation. As a general rule, secondary pollutants should be sealed off or excluded from the home altogether. Or, if ventilation is determined to be the most cost effective solution (frequently in retrofit situations), then each case must be considered individually.

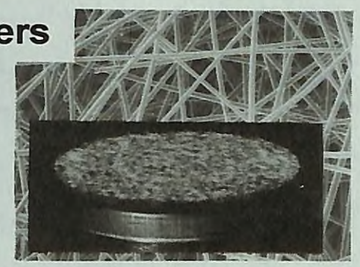
Two significant steps have already been taken to acknowledge the difference between primary and secondary ventilation. In Canada, the R-2000 Program has recognized the venting of combustion products as a secondary need. They require the use of sealed combustion or induced draft fuel-burning appliances.

Internationally, France has recognized the difference between primary and secondary ventilation needs. In 1980 they relaxed their continuous ventilation requirement in housing. They now permit a system which has equal continuous capacity as before, but which remains all but closed at times of low need. This decision focuses directly on the primary ventilation needs of the home, to the exclusion of secondary problem pollutants.

Increasing energy costs and homeowner's demands for increased comfort have resulted in tighter homes. Today more and more building products are being made from synthetic materials. With no emission regulations in place, harmful pollutants are out of control. The combination of these practices and our increasing awareness of other harmful pollutants such as radon forces us to take action. The ventilation industry has two choices: lump primary and secondary needs together and develop 'hurricanes', or separate the needs and develop standards for quiet, controlled, quality primary ventilators.

David Hill and Yvonne Kerr are with Eneready Products Ltd., a ventilation products distributor.

Flameless Gas Burners



A gas burner without a flame? It sounds like a contradiction!

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This gas burner made from silicon and carbon is a spin-off from the aerospace industry. The low mass ceramic fibre burner has instant heating capability (at up to 100 Watts per square centimetre) yet it looks like heating elements in smooth top electric ceramic cooktops with the black ceramic glass. The gas burner glows red hot and passes infrared energy by radiation and conduction through the glass ceramic panel to the pan. It responds instantly to gas or air modulation. The cooking time with this burner is the same as with an electric element.

Why bother? In many areas, gas is the fuel of choice for cooking. Burning natural gas in this burner produces no visible flame (it glows), and it emits little pollution - CO and NOx emissions are supposed to be well below the stringent 'Blue Angel' limits in Europe.

Even though the surface temperature for a relatively thin burner plate (4.5 mm) is high, the backside temperature is normally below 60°C. The flameless burners can be fabricated as plates, discs, and cylinders of various sizes and can be mounted in metal frames for easy installation into heat exchanger units, burner pans for cooktops, or cylindrical fixtures for boilers.

You can't go out and buy an appliance with one of these burners - it's still at the prototype stage. However, interest from manufacturers is high and the developers hope that a stovetop unit will be available through major appliance manufacturers in 1994.

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The Canada Centre for Mineral and Energy Technology (CANMET) is the research and development arm of Energy, Mines and Resources. EMR/CANMET's Buildings Group works with industry to develop and commercialize the technologies to make Canadian houses more energy efficient. With the support of the Buildings Group, Solplan Review presents this information on some current CANMET projects. For more information contact: Energy Efficiency Division, EMR/CANMET, 580 Booth St., Ottawa, K1A 0E4.

Lessons Learned at Closeleigh Manor

Closeleigh Manor is a 3 storey, 30 suite, 3140 m² apartment building for seniors located in Whitehorse, Yukon. It was the first building of its kind to be built to the R-2000 performance standard. The purpose of the project was to learn more about the cold climate operation of energy efficient, multi-suite residential complexes. To this end, detailed monitoring was done from 1988 to 1992. As a result, many changes were made in the building systems. A number of lessons were learned:

1) if systems in energy efficient buildings are to be properly sized and performance optimized, "accepted practice" standards and guidelines must be reviewed.

2) To optimize systems it is necessary to consider all operating conditions, not just the worst case "design-day" standards and guidelines must be reviewed.

3) Systems must be kept as simple as possible

4) Building operators must be trained and residents informed so that the efficiency of systems is not undermined.

Specific building component lessons include:

Windows:

1) Mechanical systems must be operated correctly to reduce tenants' need for open windows

2) In cold climates all windows, not just north-facing ones, should be high performance triple glazed to control heat loss and condensation

3) Instead of full casement windows, fixed windows and small openable awning windows at the top are better.

HRV systems

1) High performance systems with a minimum effectiveness of 60% should be used. Electrical needs of fans and pumps should be considered when assessing cost effectiveness.

2) Systems design must include high-quality dampers for balancing supply and exhaust air and building commissioning must include system balancing.

3) Ventilation rates of 0.4 ACH are perfectly adequate (1 ACH is unnecessary and not energy or comfort efficient).

4) Systems must include duct sealing, diffusion supply grills to control drafts, attenuation ducts for noise and location of outside supply hoods away from pollutants and exhaust hoods.

Electrical systems

1) Energy efficient appliances and lighting systems can reduce overheating in suites and to help control electrical loads.

2) All electrical motors should be high-efficiency units.

Boiler/Heating systems

1) Only dedicated systems, not linked to the DHW system should be used.

2) The pick-up capacity - provided by reducing the ventilation rate (ACH) - be considered at the design stage for proper sizing of heating plant.

3) Multiple speed motors be considered for space heating circulation pumps to accommodate different flow rates and pressures caused by many control valves calling for heat.

DHW System

1) Use dedicated domestic hot water systems

2) Low-flow water fixtures and low-water usage appliances be used

Cooling system

It should not be assumed that energy efficient residential buildings will need cooling systems

Building Operation and Maintenance

1) Bi-annual seminars (at the beginning of the heating and cooling seasons) for tenants on operation of heating and ventilation systems, including proper window use would be useful.

2) An operations manual for each different condition with appropriate building system equipment settings be developed as part of commissioning.

It is hoped that the valuable lessons learned from the monitoring of the Whitehorse complex will be put to good use through their implementation in future projects of this type.

Energy Efficient Buildings Around the World

IEA Task XIII activities

Fourteen countries are designing, building and monitoring low-energy residential buildings as part of the International Energy Agency's Solar Heating and Cooling Program - Task XIII. Canada's study building is the Advanced House built in Brampton in 1989.

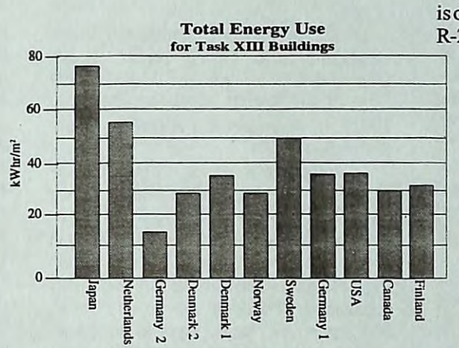
Although the houses are located in widely differing climates there are many similarities in design. All, except Canada's, are modestly sized with an average floor area of 130 m² (1400 sq.ft.). All except Japan's, are superinsulated. All use high performance windows mostly facing south. Air-tight building envelopes with mechanical heat recovery ventilation systems are common to all.

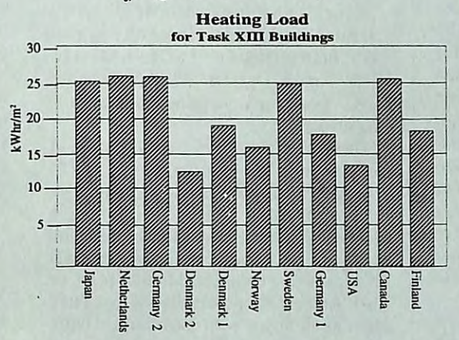
Many of the designs have small functional sunspaces. The Canadian and Dutch designs temper ventilation air in this space; the Norwegian design uses the sunspace as an entry airlock.

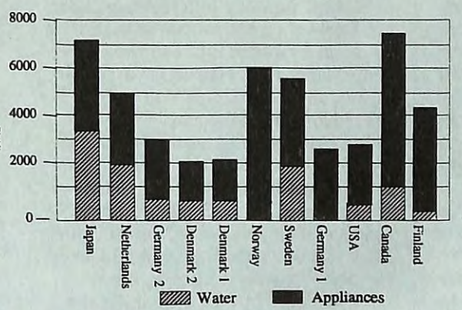
Heating systems vary with the predominant heating source. Most of the European buildings are connected to district heating systems; Canada, Finland, Japan and Norway use electrical heat pumps. Canada and Norway heat DHW with heat pumps; all other designs use solar DHW heating systems.

The total energy consumption, energy load, and heating load for the eleven buildings is summarized in the tables. Energy use is not climate dependent as one might expect. In addition, in very low energy houses the energy draw from pumps and fans is often a high proportion of total energy use (25% in the Canadian house).

The predicted total energy consumption of seven of the buildings falls within the 30 to 36 kWhr/m² range. The German *Ultra-Haus* uses an active solar heating system with seasonal storage to supply all the space and DHW heating load, to result in a predicted annual consumption of only 15 kWhr/m². The high energy use of the Japanese house is due to a relatively high appliance energy use combined with the high DHW heating load - Japanese use twice as much hot water as Canadians. However, the average annual energy consumption of the IEA buildings is only 39 kWhr/m² which is one third the consumption of an average R-2000 home. The ten Canadian Advanced houses now nearing completion have an average consumption of 49 kWhr/m².







The energy use for hot water heating and appliances including lighting and fans in the Canadian house has an estimated load of 7200 kWhr. Though high in comparison to other buildings (except Japan's) this still is a significant reduction from the average Canadian home use of 13,000 kWhr (5,000 kWhr for hot water and 8,000 kWhr for other electric loads).

Innovations

The Norwegian row house has an integrated mechanical system with an air-to-air heat exchanger and a heat pump heat recovery unit. Recovered heat from exhaust air is used to heat DHW and meet space heating needs. A photovoltaic system supplies one third (2,000 kWhr) of the building's total electric load.

The Dutch building incorporates a 6 storey high, vented and shaded sunspace which connects three small apartment blocks. This sunspace preheats ventilation air for individual suites, virtually eliminating frosting in the heat exchanger. A high efficiency air to air heat exchanger provides extra heat for ventilation air tempering.

The German sunspace is fitted with sophisticated, water cooled, active solar shading blinds. The blinds are composed of tubular solar collector fins which are white on one side and selective surface on the other. Water is circulated through the tubes to supply DHW needs and to cool the blinds. At night the blinds are closed and heat loss is only 1.69 W/m² /°C (same as triple glazed windows with low-e coating). In summer the white side of the blinds is turned out to reflect most of the solar gain, water keeps blinds cool, and the inward facing selective surface reduces radiative heat gain to rooms. This system is superior to all other interior

shading systems and has results similar to exterior venetian blinds without the associated problems.

The Swedish design incorporates hollow core floor slabs as a combined heating and cooling system. The home is slab on grade, insulated above and below the hollow core slab, with a low-temperature hydronic floor heating system in a thin slab on top of the insulated assembly. The hollow cores act as a 70% efficient air-to-air heat exchanger and carry supply and exhaust ventilation air. A hydronic coil tempers incoming supply air so it is always warmer than -4°C.

The flow pattern in the floor can be adjusted by the homeowner to control fresh air entering each room. No additional heat is required for supply air, since it never drops below 13°C. In the hydronic system, supply water at 30°C meets space heating needs. The water circuit is then split into two: one circuit for ventilation air preheating and one for domestic hot water heating. The low return temperature of 10°C can be supplied by a low-temperature source, such as active solar or industrial waste heat.

Innovative Housing '93

This international conference on energy efficient and environmentally responsible housing in Vancouver, B.C. June 21-25, 1993, co-sponsored by EMR and CMHC with the support of CHBA and the International Energy Agency (IEA) has attracted delegates from over 30 countries that include builders, manufacturers, researchers, planners, designers, policy makers and regulatory officials.

It will be the international forum for the exchange of new ideas about innovative residential building technologies.

Register for the conference by contacting:

Innovative Housing '93 Conference
c/o Events by Design
#601 - 325 Howe St.
Vancouver, B.C. V6C 1Z7
Tel: (604) 666-9193
Fax: (604) 669-7083

Letters to the Editor

Sir,

I was surprised, but not unhappy, to see an abstract of the CMHC report "Hard-Ducted Make-up Air for Ventilation" (SOLPLAN REVIEW No.47, Oct/Nov 1992). It obviously has stirred-up some discussion.

I would like to make it clear to your readers that I did not write the abstract nor have any knowledge of your intent to publish it prior to publication. There is always a danger of a reader misinterpreting statements that may be out of context because of the need for brevity when condensing a 47 page report to one page.

I would like to respond to Mr. Bowser's comments and HRAI's letter of endorsement, both published in SOLPLAN REVIEW No 48 (Dec/Jan 1992), as they are based upon misconceptions and significant errors.

One part of the project involved a field study of furnaces installed in 2 year old houses to see if hard connection of fresh air ducts to furnace return air systems were causing premature corrosion of heat exchangers on naturally aspirated furnaces. This study was conducted in the spring of 1991. At that time nearly all houses of that age were equipped with conventional naturally aspirated gas furnaces - the report and terms of reference refer to spillage susceptible furnaces with standing pilots. Mr. Bowser's criticism that now all new gas furnaces sold in B.C. and Ontario are mid efficiency types is true, but irrelevant, as the study was conducted in early 1991 when that was not the case.

Mr. Bowser criticizes the fact that the report discusses the 13°C return air temperature requirement to avoid condensation in ductwork and furnace heat exchanger rather than the 15.5°C limitation of one manufacturer of mid-efficiency furnaces - he calls it a glaring error.

Nonsense! The report did not address the 15.5°C limitation because it was not in the terms of reference and not an issue at that time. Mid-efficiency furnaces were very new. I believe Lennox was the first and only manufacturer to raise a concern, and that was not documented until early in 1992. Other manufacturers have been slow to follow Lennox's lead and add this limitation in their warranty and installation manual as has Lennox. Thus I do not believe the lack of a discussion of a limitation set by one manufacturer one year after the study was conducted is a "glaring omission". The terms of reference only related to concerns of rusting of conventional gas furnace heat exchangers due to condensation of water vapour contained in basement air.

Mr. Bowser states that the discussion of mixed air temperatures was based upon calculation only and that there were no measurements and no field observation is also incorrect. A reading of the complete report would plainly reveal this is not true.

The air flow in the fresh air duct was measured with a calibrated hot-wire anemometer and the total air flow through the system was determined using a temperature rise test and calculation similar to that provided by George Pinch of B.C. Hydro in the Dec/Jan 1993 issue. This is the standard and probably most accurate and practical method of measuring air flow in a large rectangular duct. Since we knew the return air temperature of the house, the only calculation that was required was the mixed air temperature in the return air duct based upon outdoor design temperature. The calculation is based upon accepted industry methods, also included in the HRAI Residential Air System Design Manual, and should provide very accurate indications of mixed air temperatures.

In addition, a special test house with temperature, pressure and flow sensors located throughout the ductwork and house, continually computer monitored for approximately two weeks was also used. This provided mixed and delivered air temperature information under a variety of conditions that would be expected to occur in a normal home. The results from the test house verified the accuracy of calculated mixed air temperatures, though that was not in the terms of reference. The air temperature at the air intake, all through the duct work, the furnace and at the register was recorded and reported, contrary to Mr. Bowser's letter.

Mr. Bowser refers to a "glib" reference to an electric duct heater for pre-heating fresh air "as there is only one certified for such use". So What! How many have to be certified before they are mentioned in a report? Lennox had the only high efficiency gas furnace on the market for some time, does that mean reports should not mention it?

Mr. Bowser and HRAI have unfortunately misunderstood the reference to the fact that, despite extensive HRAI training courses, some contractors still do not have a good understanding of basic physics, air movement or ventilation. This appeared in the "Recommendation" section of the report and must be taken in context with statements included in the "Conclusion". This was not a criticism of the courses offered by HRAI or the students that have attended those courses. What it says is, that more training courses are required and more contractors must take this training. Only a small number of Canada's heating contractors are HRAI members. Many others may not have access to the training because of their geographic location or may not be aware of its availability and importance.

The courses available at the time of report writing were not, in my judgement, and borne out by the installations I examined, broad enough nor intended to deal adequately with other methods of meeting the requirements of provincial building codes, as applied to regular houses. Therefore, my point "better and more training courses delivered by knowledgeable trainers may help" refers to courses on how to install ventilation systems in accordance with the building code requirements of each province (there are many differences among provincial code requirements). This was to encourage CMHC or some other body to facilitate or provide funding assistance for the development of such courses and the training of instructors. In summary, the report did not criticize HRAI or its instructors. Mr. Bowser must have been attempting to read between the lines.

The comments on installer qualifications in the report were not based only upon the visit to the 13 Ontario houses tested, but also visits to houses in other provinces and many under construction in Toronto. The Toronto area home visits were done near the end of the project to determine how installers were, at this later date, meeting the Ontario Building Code Ventilation requirements. What we found, in attempts to provide builders with low cost solutions to ventilation requirements, confirmed that "some" designers and installers (the report does not say most or many - just some) had little understanding of "basic physics, air movement and ventilation" - also the opinion of the building official. This is not a criticism of the industry, just a fact that most people in the industry already knew. This is why training is so important and more is needed.

As an example, just a few of the interesting approaches to exhaust air ventilation systems (low cost systems commonly found in Ontario at that time) that we found:

1. Wide open make-up air holes through the basement sill plate (often two or more 6" to 8" in diameter, side by side). Aside from the impact on the structural integrity of the sill plate, these openings make it impossible to maintain the building code's basement temperature requirements - but that's another matter.

2. To solve the cold basement problem, one installer had attached a 30 foot uninsulated duct to the make-up air opening. The purpose, to allow the air to warm-up before being discharged from the duct. Of course the duct would be covered in condensation during cold weather. In addition, the size of the make-up air opening required was based upon a free air opening, when the ductwork was attached, the opening was no longer large enough to meet code requirements.

3. Another installer thought he solved the condensation problem by installing a long insulated duct with a vapour barrier. Naturally, the insulation prevented the cold ventilation air from warming, largely defeating the purpose of the long duct. The connection of any duct to the make-up air opening meant that you could no longer use the Part 9 ventilation requirements of the building code. The ventilation system would then have to be designed according to Part 6 - something most installers were trying to avoid. If Part 6 had been used, the installer would also have had to install a larger duct because flexible ducts have a greater resistance to air flow than metal ducts.

4. Most of the fresh air ducts seen were either not insulated or if insulated, had no vapour barrier.

I am disappointed in Mr. Bowser's letter. I believe it is unnecessarily defensive, unprofessional, contains many inaccuracies (considerably more than the report he criticizes) and is largely nit-picking at a competitor. It not only criticizes the project manager, the other competent consultants and gas utility personnel across Canada that participated in the project, but also the CMHC staff that initiated, managed, accepted and reviewed the report. Since HRAI and its Executive endorsed Mr. Bowser's letter, perhaps this applies to them also. Before publication, CMHC circulated this report to several gas utilities across Canada and others for comment. It is surprising that none of the competent reviewers raised the issues contained in Mr. Bowser's letter.

A further comment on Mr. Pinch's letter, the formula he provided is correct and reflects the methodology used in the study, however, the tempering referred to in the report is tempering of the cold ventilation air as it passes through ductwork exposed to warm indoor air. In other words, it is difficult to anticipate exactly how much heat gain will occur through the duct system, prior to cold outdoor air reaching the furnace heat exchanger. Having said that, I would also like to thank him for providing the formula to calculate mixed air temperature. It was the same method used in the report and criticized by Mr. Bowser.

W. Douglas Geddes
Bramalea, ON

Sir,

We read with interest Peter Moffat's article "The Bermuda Triangle: Airtightness, Ventilation and Insulation" (SOLPLAN REVIEW, Feb/Mar, 1993). The main portion of his article raises a number of issues that will certainly add to the debate and will no doubt trigger many responses. However, the tie-in to our article "Air tightening New Houses for Improved Energy Efficiency - What is

the Potential?'' (SOLPLAN REVIEW, Dec/Jan 93) was tenuous at best, and his arguments misrepresented our research approach and results.

In the preface of his article, Mr. Moffat incorrectly attributes a conclusion to us. Our message was that many builders across Canada are already building very tight houses, with tested normalized leakage areas (NLA's) below the threshold values identified in our study. For those builders, any further air tightening of the houses they build must now be accompanied by ventilation system improvements if additional energy efficiency is to be achieved without sacrificing indoor air quality. We did acknowledge, however, that not all builders have reached that point, and for them our message was to improve their airtightness practices. Mr. Moffat provided some useful information that may require more attention by builders in the Vancouver area.

For Mr. Moffat to say that we ''paid no attention to the range of housing airtightness values...'' and to imply that we defined ''a typical new Canadian house based on the average measured airtightness statistics'' is incorrect. The very crux of our study was to evaluate the energy impact of a full range of airtightness characteristics in each of five cities across Canada: Halifax, Montreal, Toronto, Winnipeg and Vancouver. Threshold NLA's were identified for each location based on simulations using local weather data. At no point in our research were any airtightness characteristics or results averaged on a national basis.

Our work has been documented and was presented in October 1992 at the 5th International Jacques Cartier Conference (''Indoor Air Quality, Ventilation and Energy Conservation'') in Montreal, in a paper titled ''The Potential for Energy Conservation Through Air Tightening of New Canadian Houses.'' It will be reprinted in Indoor Environment (the Journal of Indoor Air International) in the summer of 1993.

M.C. Swinton and J.T Reardon
Institute for Research in Construction
National Research Council of Canada

Technical Research Committee News

Canadian Home Builders' Association

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector. Members include builder members and representatives from industry, standards and governments bodies with an interest in housing. Anyone with a problem, technical question or suggestions for areas that need to be investigated is encouraged to contact their local Home Builder's Association technical committee or the TRC directly.

To contact the TRC:
Canadian Home Builders Association,
Suite 200, 150 Laurier Ave. West,
Ottawa, Ont. K1P 5J4
Tel: (613) 230-3060

Proposed National Building Code Changes

The National Building Code is always being reviewed. The final series of proposed changes for the 1995 edition of the National Building Code will be released for public review in August, and comments on the changes will be accepted until October 29, 1993.

Some of the more significant changes being proposed include:

Cellulose Fibre Insulation

Changes proposed will allow cellulose fibre insulation in sloped attics (scissor trusses) up to 2.5/12 slope. In addition, it is proposed to allow blown-in cellulose in walls where it is blown dry. Systems which use water will have to be used on the basis of CCMC evaluations.

Room and Space Dimensions

Recognizing the proven acceptability of rooms and spaces (such as those in mobile homes) which are smaller than those now specified in the Code, it is proposed to delete many of the minimum room dimension requirements in Section 9.5. Those requirements that will remain deal with ceiling heights and hallway widths.

Crawl Spaces

A new more rational approach to crawl space requirements is being proposed.

Mechanical Ventilation

A prescriptive alternative to CSA F326 has been finalized. Still not completely resolved is how to deal with depressurization in houses with combustion gas spillage sensitive equipment, but the approach being proposed is to require make-up air where there are exhaust devices with a capacity greater than 90 L/s. (190 cfm).

By the time the 1995 NBC comes into force, most houses will be using power vented or direct vent furnaces (not sensitive to spillage) because the higher efficiency equipment will be dictated by provincial energy efficiency acts. Many will also be using non-spillage-susceptible water heaters. And even where spillage-susceptible water heaters are used they do not operate as frequently as furnaces.

A carbon monoxide (CO) detector will be required in any house where there is an open fireplace.

Wood Roof Trusses

The truss span tables will be eliminated and the design procedures of the Truss Plate Institute of Canada will be cited as an example of good engineering practice. This will permit the continued use of these procedures by the industry.

Vapour Barriers

Compliance with the CGSB standard for polyethylene vapour barriers (i.e. 6 mil poly) will only be required where the poly acts as an air barrier. Where some other means of providing the air barrier is used (e.g. airtight drywall approach), lighter poly will be permitted to be used to provide the vapour resistance.

The Institute for Research in Construction, will present a series of Code Change Forums across Canada later this year to review the proposed changes. If there are sections of the code that don't make sense to you, that you think should be changed, now is the time to do your homework.

Copies of the proposed changes can be obtained free of charge from:

Public Review
Canadian Codes Centre, IRC
National Research Council of Canada
Ottawa, Ontario K1A 0R6
Tel: (613) 993-9960
Fax: (613) 952-4040

R-2000 positioned as the Green Home

When the R-2000 program was developed in 1980 the average Canadian home had R-20 ceilings, R-12 walls, no insulation in the basement and windows that usually were single glazed. Since then, in part based on the success of the R-2000 Program, the way the average Canadian house is built has evolved to the point where there is little difference between current building practices and the R-2000 Technical Requirements. R-2000 is a performance standard that takes into account the geographic location of the house.

To reflect changing technologies and innovation in the building industry and keep R-2000 at the leading edge, the Technical Requirements are being revised. Changes to the energy target being proposed will take into account space heating, domestic hot water, space cooling, lighting and appliances. At this time, only heating and domestic hot water are being considered.

The space heating energy target has been reduced by about 20% on average. The advantage that larger houses had in meeting the energy target has been adjusted, thus helping smaller, more resource efficient houses to meet the budget.

Minimum window requirements are being increased and a movement towards the use of ER numbers for windows introduced. ER ratings have been in use in Ontario for over a year now, as they were part of Ontario Hydro's energy efficient window program. It will mean a minimum use of low-e windows in most areas.

A prescriptive requirement has been added to ensure the most efficient furnace fans are used, as well as requirements for energy efficient lighting.

Indoor Air Quality

Much has been learned about indoor air quality, radon, emissions from building materials and the effects on occupant health. The R-2000 Program has always been concerned with the quality of indoor air for the occupants. In the past, the way of dealing with pollutant loading in the house was to increase ventilation rates, but that is not always the best way to do it. Changes are moving to a combination of dilution and source control.

Source control is being addressed through the selection of building materials to be used inside the air barrier. The proposed Technical Requirements will provide the builder with a ''pick list'' of options. From the list of options (materials used inside the home) the builder will be required to pick two items in order to comply with the program requirements. This will be expanded in future upgrades as new materials and information becomes available.

Environmental Responsibility

Concerns have been raised regarding the environmental responsibility of housing. The R-2000 Program is addressing these issues in two areas: water conservation and materials conservation. For water conservation low flush toilets, low flow shower heads and tap aerators are being required.

A ''pick list'' approach has been incorporated for the materials conservation section to allow the builder maximum flexibility in materials selection to meet the requirements.

The proposed changes have been developed in consultation with members of the building industry and housing program officials. The opportunity now is to properly present the new look of R-2000 to both the housing industry and more importantly to the buying public.

Index to Solplan Review No. 1 to 49

This index covers issues No. 1 to 49. As many readers keep their copies for future reference, the index will make it easier to find items that appeared in past issues. Items have been listed by titles and, where appropriate, by subject area. Short items of a news nature and some commentaries have not been listed.

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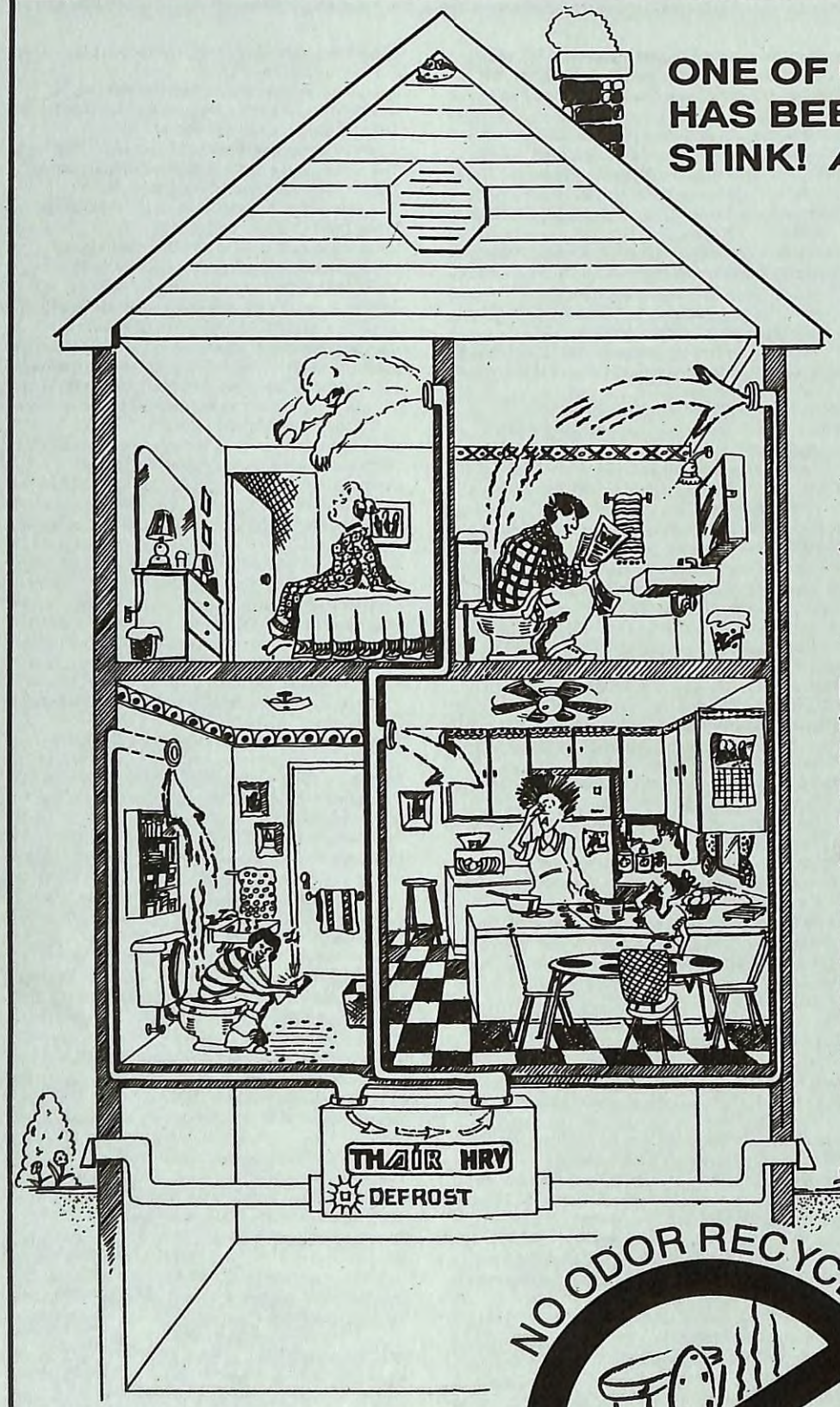

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